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Costs of Saving Water in South Texas with Irrigation District Infrastructure Rehabilitation

– Using Capital Budgeting with RGIDECON© –

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Water shortages have always been a critical issue for deep South Texas, but the situation has become more acute since the 1990s, due to rapid population growth (from 1.26M to 3.05M by 2050), shortfalls in delivery of water from Mexico over many years, and prolonged drought conditions. The severity is reflected in the region's supply of raw-water (in Amistad and Falcon Reservoirs) which reached a record low level of 17.5% in 1998, and today sits near 39%.

In reaction to the scarcity of the late 1990s, subsequent planning by stakeholders identified alternatives capable of adding to the region's supply by manufacturing (e.g., desalination) or through efficiency improvements in water transport, or usage. That is, irrespective of comparative economic and financial costs, the region determined it could develop alternative sources to the Rio Grande [River], as well as conserve available supplies.

Approximately 98 percent of the raw water demanded by agriculture, municipal, and industrial users in deep South Texas is delivered by local irrigation districts (IDs) through a vast infrastructure system. This system consists of approximately 24 Rio Grande diversion pumping stations, 800 miles of main canals, 700 miles of laterals, 1,700 miles of pipelines, and several in-district reservoirs.

Recognizing the seriousness of the water crisis in South Texas, the U.S. Congress enacted Public Law (PL) 106-576, and the subsequent, amending legislation PL 107-351. The former is known as *The Lower Rio Grande Valley Water Conservation and Improvement Act of 2000*, with the later Act similarly known, albeit for 2002. Within these Acts, Congress authorized investigation into water conservation projects for irrigation districts relying on the Rio Grande for their municipal, industrial, and agricultural irrigation supply of water. Subsequent to the legislation, IDs further developed formal engineering and financial plans for their authorized projects, in anticipation of future appropriations.

As a part of the ID plans, economists with Texas AgriLife Research and the Texas AgriLife Extension Service (through the Rio Grande Basin Initiative), developed and applied a spreadsheet model RGIDECON© (Rio Grande Irrigation District Economics) to facilitate unbiased comparisons of real project costs. That is, a Capital Budgeting – Net Present Value (NPV) methodology, combined with calculation of annuity equivalent (AE) values, was developed to incorporate different initial construction costs, annual operation and maintenance costs, quantity of water saved, expected useful life, etc. of the various alternative projects. Using this combined approach allows for calculation of a single, annual $/acre-foot (af) {or $/1,000 gal} life-cycle cost, comprehensive of all relevant financial and economic parameters, thereby facilitating comparisons across and priority ranking among ID projects.

Results from projects which had their comprehensive economic and financial life-cycle costs of saving water, calculated using the RGIDECON© model (refer to References for individual project reports), are presented below in Table 1. Life-cycle costs of saving water (via irrigation district infrastructure rehabilitation) are shown for individual project components, and a weighted average (based on af of water savings associated with each component) is presented for the combined, aggregated project. For example, the cost of saving water with the four Harlingen ID components ranges from $22.58/af to $83.83/af, and is an aggregate, weighted, combined cost of $46.99/af. Overall, life-cycle costs for RGIDECON©-analyzed projects range from a low of $12.16/af to a high of $427.27/af, and are estimated to save more than 65,000 af per year (Table 1).

Table 1. Select data and life-cycle costs of saving water with infrastructure rehabilitation using RGIDECON©, Rio Grande Valley irrigation districts, 2002-2009.

District / Component	Estimated Initial Construction Cost ($)	NPV of Net Total Cost ($)[a]	NPV of Lifetime Water Savings (AF)[a]	Useful Life (years)	Annual Water Savings (AF)[b]	Cost of Saving Water ($/AF)[b]
HARLINGEN						
1 Canal Meters & Telemetry	$756,761	$1,558,197	21,617	15	1,855	$83.83
2 Canal Lining	$349,031	$235,301	12,561	20	895	$22.58
3 Pipeline	$1,397,786	$936,099	48,869	49	2,275	$26.56
4 Farm Delivery-Site Meters	$649,816	$1,042,775	48,030	10	5,483	$24.27
Aggregate	$3,153,394	$3,772,371	131,076		10,508	$46.99
EDINBURG						
5 Curry Main - pipeline	$895,424	$425,464	48,509	49	2,258	$12.16
6 N. Branch/E.Main - pipeline	$3,748,425	$1,232,675	70,013	48	5,838	$15.58
Aggregate	$4,643,849				8,096	
SAN JUAN						
7 Wisconsin - pipeline	$1,013,024	$506,799	20,989	49	977	$33.49
8 Lateral "A" - lining	$2,168,606	$1,947,897	54,610	49	2,542	$49.47
Aggregate	$3,181,630	$2,454,696	75,598		3,519	
BROWNSVILLE						
9 Main Pipeline	$2,504,435	$960,461	40,208	49	1,872	$33.13
SAN BENITO I						
10 Interconnect - lining	$3,278,276	$2,899,857	196,105	49	9,129	$20.51
11 Pumping Plant	$7,273,360	$1,574,634	46,643	48	2,171	$46.82
Aggregate	$10,551,636	$4,474,491	242,747		11,300	$41.26
SAN BENITO II						
12 Canals B, C, and D - lining	$3,296,000	$2,900,884	153,971	49	7,167	$26.13
13 Canal B Laterals - pipeline	$4,396,000	$3,637,960	124,954	49	5,817	$40.37
14 Canal C Laterals - pipeline	$2,646,000	$2,339,578	34,760	49	1,618	$93.34
15 Old District 13 Canals - lining	$2,996,000	$2,764,563	93,078	49	4,333	$41.19
16 Old District 13 Canals - pipeline	$826,000	$696,657	13,849	49	645	$69.76
Aggregate	$14,160,000	$12,339,641	420,612		19,580	$40.68
EAGLE PASS						
17 Main Canal - lining	$4,509,819	$4,179,406	173,660	49	8,084	$33.37
SAN JUAN II						
18 Alamo Main Canal - relining	$2,500,000	$2,400,243	13,215	49	615	$251.87
19 Install Flow-Mg,t System	$570,000	$251,052	3,659	20	261	$82.69
Aggregate	$3,070,000	$2,651,294	16,874		876	$200.59
UNITED						
20 Main Canal & Lateral 7N - pipe	$4,707,258	$3,259,829	10,741	50	486	$427.24
21 Laterals & Sub-Laterals - pipe	$9,181,987	$5,197,159	22,781	50	1,036	$320.24
22 Rehab Diversion Pumping Plant	$123,542	($251,881)	0	25	-	$0.00
Aggregate	$14,012,787	$8,205,107	33,521		1,522	$200.59
SAN JUAN III						
23 Pipeline Unit I-7A	$1,184,751	$735,531	2,465	49	115	$413.84
24 Pipeline Unit I-18	$1,881,500	$1,286,041	5,116	49	238	$348.63
25 Pipeline Unit I-22	$1,901,830	$872,833	2,833	49	132	$427.27
Aggregate	$4,968,081	$2,894,405	10,413		485	$385.46
Combined (All)	**$64,755,631**				**65,840**	**$44.76**

[a] Determined using 2.04% inflation and a 6.125% discount factor for dollars, and a 4.0% discount factor for water savings.

[b] Annuity equivalent values.

Further analysis and grouping of the 25 project components above from Table 1 into project types reveal differences which can be useful in the preplanning phases of a project (Table 2). As shown in Table 2, the on-farm meters and telemetry project, and lining projects are the most cost-effective rehabilitation projects at saving water with an 'average' $24/af and $35/af life-cycle costs, respectively. Note the seven lining projects analyzed represent both protected and non-protected types, an array of project lengths, and lining materials (Table 2).

The two pumping-plant related projects 'average' $47/af life-cycle cost, while the 13 pipeline projects analyzed have an 'average' life-cycle cost of saving water of $56/af (Table 2). Note that the pipeline projects represent a range in pipe diameter and material types (e.g., reinforced concrete, PVC). The two in-system meter and telemetry projects have an 'average' life-cycle cost of $83/af to save water, while the one on-farm meter and telemetry project has an 'average' life cycle cost of $24/af to save water. Overall, water saved via rehabilitation of irrigation district infrastructure is estimated to cost $45/af, based on the 25 projects analyzed which are estimated to save 65,840 af/year and cost $64,755,631 to construct (Tables 1 and 2).

Table 2. Life-cycle costs of saving water, by rehabilitation project type, Rio Grande Valley irrigation districts, 2002-2009.

Project Type	Cost to Save Water ($/AF)[a]
Meters & Telemetry - (in-system)	$83
Meters & Telemetry - (on-farm)	$24
Lining (protected and non-protected)	$35
Pipeline (multiple sizes)	$56
Pumping Plant	$47
Overall	$45

[a] Annual annuity equivalent, assuming perpetuity, zero salvage value, and replacement with similar capital items as their useful life expectancies end.

In summary, opportunities for and investigations into easing the stress from limited water in South Texas have taken many paths, with water conservation in irrigation district water-conveyance systems being a major area of focus because their aged water-delivery conveyance system loses substantial water from seepage, evaporation, etc. Comparisons of the noted rehabilitation costs are estimated to save significant quantities of water annually, at competitive cost-effective levels relative to other water supply enhancement alternatives of interest. The potential benefits to and economic impact on agricultural, municipal, and industrial users in the region are substantial.

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